Preface

Graduate students interested in the neurosciences with a special interest in behavior are the intended audience. The major aim of this book is to present up-to-date information on the neurobiology of learning and memory based on multiple levels of analysis, contributions of multiple brain regions, systems that modulate memory and applications to aging, drugs of abuse, neurodegenerative diseases, and models of enhancement of memory. The emphasis will be on both animal and human studies.

The first section of the book covers different approaches to understanding the neurobiological basis of learning and memory. More specifically, there is an excellent introduction to the history of the neurobiology of learning and memory incorporating information from all of the contributing authors (Rosenzweig). With three chapters the book covers the developmental and genetic contributions to memory. This topic is becoming very important with the discovery of a variety of genetic tools to examine the role of specific genes and their contribution to learning, memory formation, and memory storage and retrieval (Markham, Black, and Greenough; Wang, Dubnau, Tully, and Zhong; and Martinez, Thompson, and Sikorski). Plasticity as it relates to memory has played a critical role in delineating the cellular properties of neurons that can maintain information over time (Mizumori and Smith). There is one chapter that emphasizes the role of place cells in the hippocampus and interconnected neural circuits based primarily on an electrophysiological analysis of cellular changes associated with learning and memory (Mizumori and Smith). There is one chapter that will cover a new area of theoretical importance for all of the different brain regions, namely the use of computational models to aid in providing a new theoretical approach to understand the processes that subserve memory (Rolls). Finally, in this section there is a chapter that covers the influence of hormonal processes on learning and memory (Korol and Gold).
The second section of the book covers the contribution of neural systems in mediating learning and memory. Since there are many brain regions associated with the processing of information of importance to learning and memory, six chapters outline a multiple system and multiple processes approach to understanding the complexity of information processing resulting in memory encoding, storage, and retrieval. The chapters deal with the following neural substrates, namely the medial temporal lobe, the frontal lobes, amygdala, basal ganglia, and cerebellum and cover experimental results and theoretical ideas based on research with humans, monkeys, and rats. Multiple approaches and techniques aimed at studying these brain regions are presented including, neuroanatomy, electrophysiology, lesion, pharmacology, fMRI, behavior, and cognitive analysis (Kesner; Preston and Wagner; Miller and Buschman; Ragozzino; Davis; Ohyama and Mauk).

The third section of the book emphasizes applications of the importance of learning and memory to applied issues. There are four chapters that provide a connection between all the previous chapters and important applications of the basic empirical findings to real world issues. The chapters cover issues of reward and drugs of abuse, the effects of aging on memory, the importance of studying neurodegenerative diseases from both the molecular and treatment approaches to memory and a final look at our ability to enhance memory (Balmier and Kalivas; Barnes and Penner; Wenk; Heinrichs).

The emphasis of each chapter will be on the presentation of the latest and most important research on the topic, the development of a theoretical perspective, and providing an outline that will aid a student in understanding the most important concepts presented in each chapter.

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